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(54) **SYSTEM AND METHOD TO DETERMINE RESPONSIVENESS OF A DRIVER OF A VEHICLE TO FEEDBACK REGARDING DRIVING BEHAVIORS**

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G06N 5/04	(2006.01)
B60W 40/09	(2012.01)

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CPC ***G06N 5/04*** (2013.01); ***B60W 40/09*** (2013.01)

(58) **Field of Classification Search**
USPC 706/11
See application file for complete search history.

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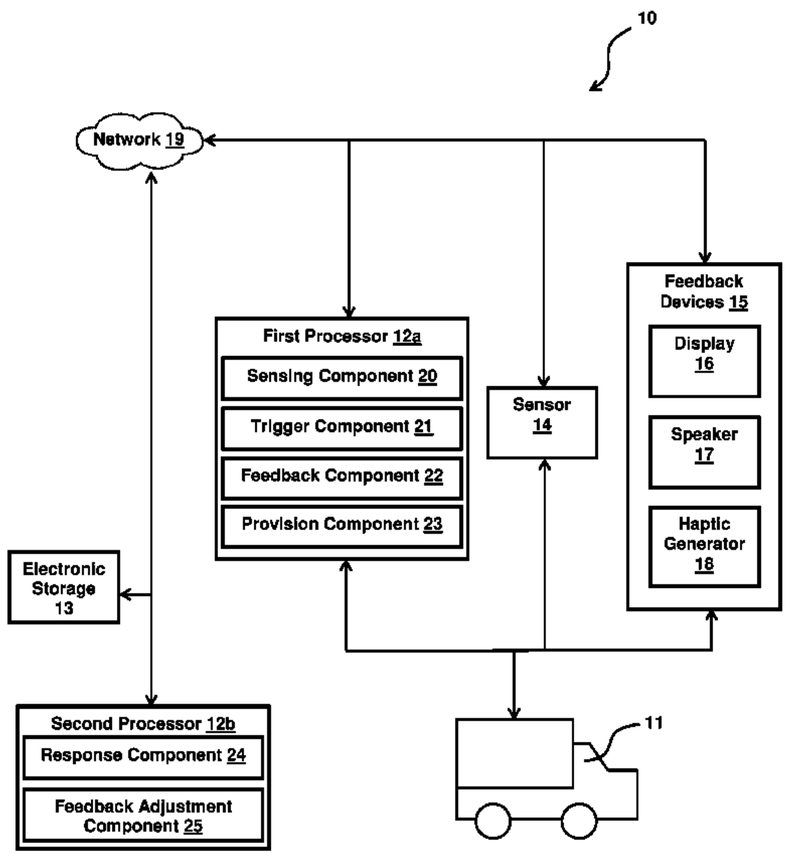
(57) **ABSTRACT**

This disclosure relates to a system and method for determining responsiveness of a driver of a vehicle to feedback regarding driving behaviors. The system may include a sensor configured to generate output signals conveying first driving behavior information, which may characterize operation of the vehicle by the driver. The system may include one or more processors configured to obtain the first driving behavior information. The one or more processors may effectuate provision of feedback defined by feedback information based on the first driving behavior. The sensor may be configured to output signals conveying second driving behavior information, which may characterize operation of the vehicle by the driver during and/or subsequent to the provision of the feedback. The one or more processors may be configured to obtain the second driving behavior information and assess responsiveness of the driver to the feedback based on the second driving behavior information.

20 Claims, 2 Drawing Sheets



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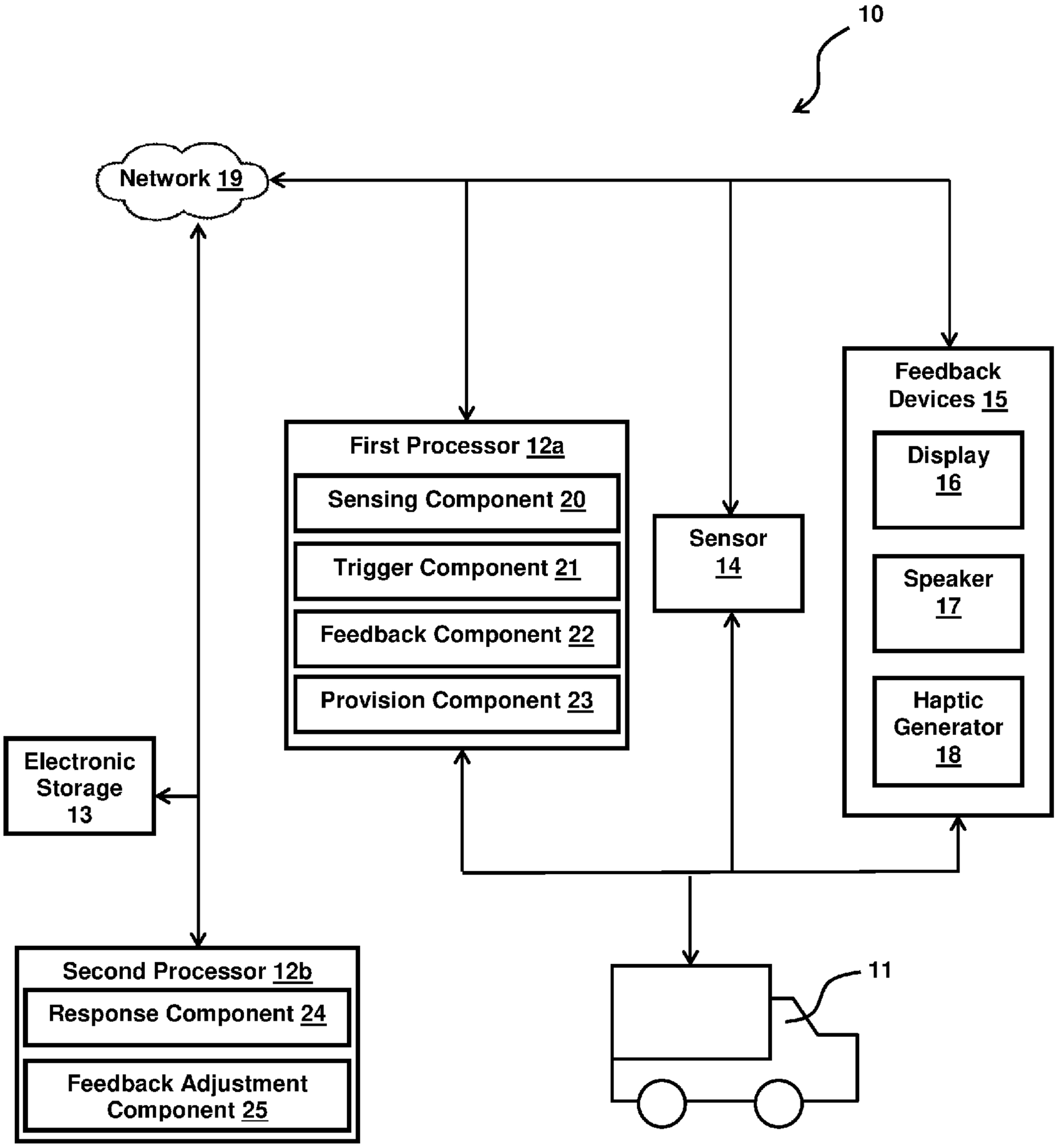
10
Network 19
First Processor 12a
Sensing Component 20
Trigger Component 21
Feedback Component 22
Provision Component 23
Sensor 14
Feedback Devices 15
Display 16
Speaker 17
Haptic Generator 18
Electronic Storage 13
Second Processor 12b
Response Component 24
Feedback Adjustment Component 25
11

FIG. 1

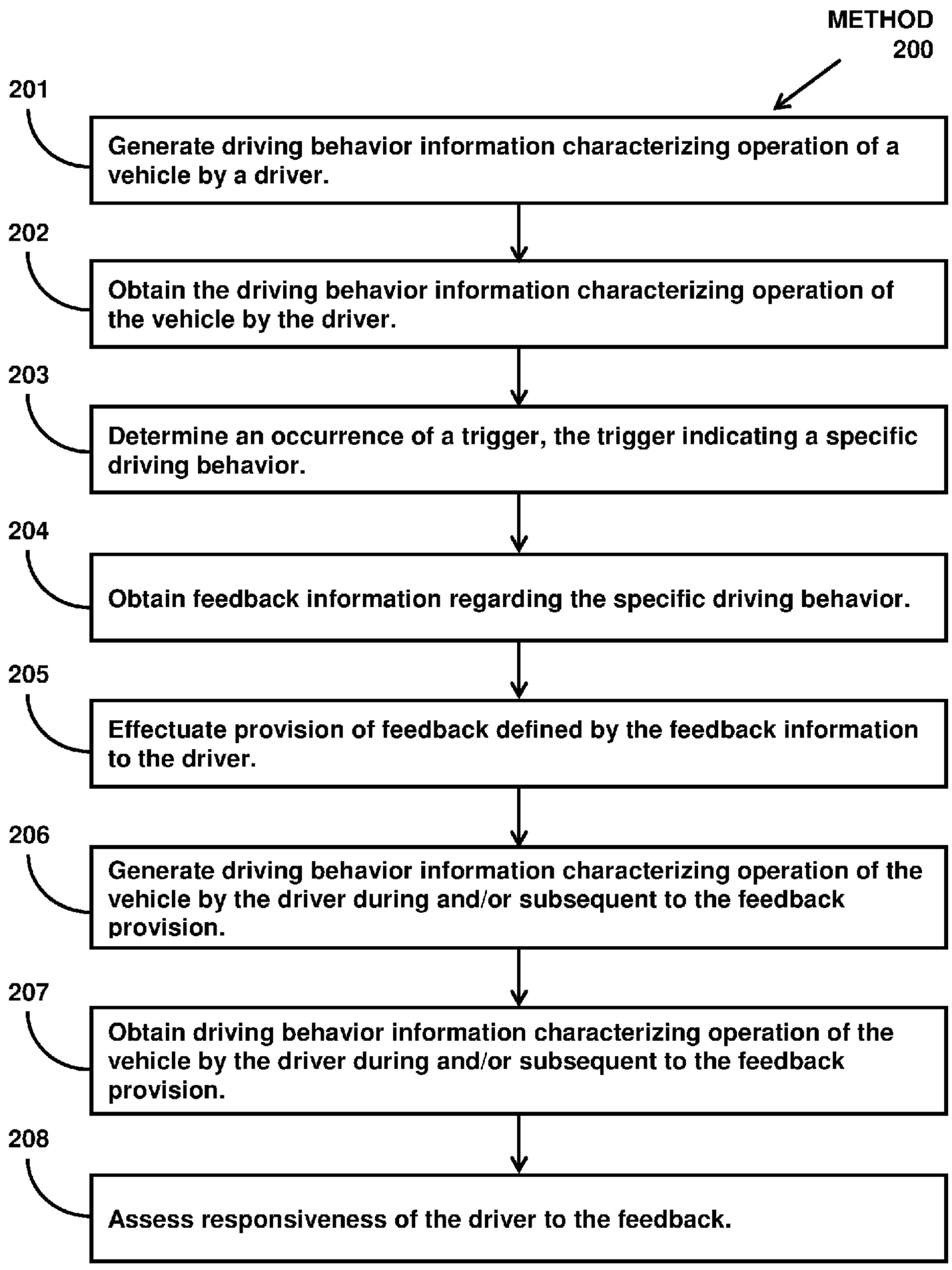
METHOD
200
201
Generate driving behavior information characterizing operation of a vehicle by a driver.
202
Obtain the driving behavior information characterizing operation of the vehicle by the driver.
203
Determine an occurrence of a trigger, the trigger indicating a specific driving behavior.
204
Obtain feedback information regarding the specific driving behavior.
205
Effectuate provision of feedback defined by the feedback information to the driver.
206
Generate driving behavior information characterizing operation of the vehicle by the driver during and/or subsequent to the feedback provision.
207
Obtain driving behavior information characterizing operation of the vehicle by the driver during and/or subsequent to the feedback provision.
208
Assess responsiveness of the driver to the feedback.

FIG. 2

SYSTEM AND METHOD TO DETERMINE RESPONSIVENESS OF A DRIVER OF A VEHICLE TO FEEDBACK REGARDING DRIVING BEHAVIORS

FIELD

This disclosure relates to a system and method for determining responsiveness of a driver of a vehicle to feedback regarding driving behaviors.

BACKGROUND

Systems configured to record, store, and transmit video, audio, and sensor data associated with a vehicle are known. Vehicle Engine Control Module (ECM) systems are known. Such systems interface with external computers (e.g., at an automobile mechanic) where the data stored by the ECM system is analyzed.

SUMMARY

One aspect of the disclosure relates to a system configured to determine responsiveness of a driver of a vehicle to feedback regarding driving behaviors. Some or all of the system may be installed in the vehicle and/or be otherwise coupled with the vehicle. The system may include one or more processors and/or other components. In some implementations, the one or more processors may be located remotely from the vehicle. In some implementations, the one or more processors may be located on or in the vehicle. In some implementations, the system may include a sensor. The sensor may be configured to generate output signals conveying one or more of first driving behavior information and/or second driving behavior information. The sensor may include one or more of image sensors, audio sensors, temperature sensors, humidity sensors, vehicle speed sensors, wheel speed sensors, proximity sensors, pressure sensors, seat belt sensors, accelerometers, tilt sensors, inclination sensors, angular rate sensors, gyroscopes, geolocation sensors, magnetometers, radar detectors, radar sensors, vibration sensors, light detection sensors, ECM sensors, physiological sensors, tachographs, user input devices, and/or other sensors. In some implementations, the first driving behavior information and the second driving behavior information may include one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information, vehicle status information, driver status information, and/or other driving behavior information.

The one or more processors may be configured to obtain the first driving behavior information. The first driving behavior information may characterize operation of the vehicle by the driver. The operation of the vehicle may be characterized by one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information, vehicle status information, driver status information, and/or other driving behavior information.

The one or more processors may be configured to determine an occurrence of a trigger based on the first driving behavior information. The trigger may indicate a specific driving behavior. The specific driving behavior may include one or more of driving maneuver, driving context, vehicle status, driver status, and/or other driving behavior.

The one or more processors may be configured to obtain feedback information regarding the specific driving behavior. The feedback information may define feedback regarding the specific driving behavior to be provided to the driver. Such feedback information may define feedback type(s) for the feedback, information to be provided to the driver in the feedback, and/or other aspects of the feedback. The feedback type(s) may include one or more of visual feedback, audio feedback, haptic feedback, and/or other feedback. The information to be provided to the driver may include one or more of identification of the specific driving behavior, description of the specific driving behavior, the first driving behavior information, instruction regarding the specific driving behavior, warning regarding the specific driving behavior, and/or any other communicable information. The feedback information may be programmed into the one or more processors, updated by the one or more processors, obtained by the one or more processors from electronic storage, obtained by the one or more processors from remote location, and/or obtained by the one or more processors in other ways.

The one or more processors may be configured to effectuate provision of feedback defined by the feedback information to the driver. In some implementations, the one or more processors may be configured to effectuate the provision of the feedback to the driver by operating one or more of a display, a speaker, and/or a haptic generator. In some implementations, the one or more processors may be configured to select one or more of the display, the speaker, and/or the haptic generator to effectuate the provision of the feedback to the driver. The one or more processors may select one or more of the display, the speaker, and/or the haptic generator based on prior driver responsiveness information. The one or more processors may make such selection based on which type of feedback provision leads to better driver responsiveness to feedback.

The one or more processors may be configured to obtain the second driving behavior information. The second driving behavior information may characterize operation of the vehicle by the driver during and/or subsequent to the provision of the feedback. The one or more processors may be configured to assess responsiveness of the driver to the feedback based on the second driving behavior information. In some implementations, the one or more processors may be configured to determine a driver responsiveness rating. The driver responsiveness rating may include one or more measurement and/or evaluation of the driver's responsiveness to the feedback. The driver responsiveness rating may use one or more characters, alphabetic characters, words, numeric characters, numbers, alphanumeric characters, roman numerals, special characters, percentages, colors, and/or other ratings. The driver responsiveness rating may reflect one or more of quality and/or quantity of the driver's responsiveness to the feedback.

In some implementations, the one or more processors may be configured to effectuate storage of driver responsiveness information. The driver responsiveness information may be stored in electronic storage. The electronic storage may include one or more of memory of the one or more processors, electronic storage coupled to the one or more processors, and/or other electronic storage. The driver responsiveness information may include one or more of the first driving behavior information, the second driving behavior information, the feedback information, information relating to the provision of the feedback, information relating to the trigger,

information relating to the responsiveness of the driver to the feedback, and/or other driver responsiveness information. In some implementations, the one or more processors may be configured to effectuate retrieval of prior driver responsiveness information. The prior driver responsiveness information may include stored driver responsiveness information.

In some implementations, the one or more processors may be configured to assess the responsiveness of the driver to the feedback based on the prior driver responsiveness information. The one or more processors may compare current responsiveness of the driver to the feedback with prior driver responsiveness information. In some implementations, the current responsiveness and the prior driver responsiveness information are based on the same trigger. In some implementations, the current responsiveness and the prior driver responsiveness information are based on different triggers. In some implementations, the current responsiveness and the prior driver responsiveness information are based on the same type of feedback provision. In some implementations, the current responsiveness and the prior driver responsiveness information are based on different types of feedback provision.

These and other objects, features, and characteristics of the system and/or method disclosed herein, as well as the methods of operation and functions of the related elements of structure and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description and the appended claims with reference to the accompanying drawings, all of which form a part of this specification, wherein like reference numerals designate corresponding parts in the various figures. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention. As used in the specification and in the claims, the singular form of "a", "an", and "the" include plural referents unless the context clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a system configured to determine responsiveness of a driver of a vehicle to feedback regarding driving behaviors.

FIG. **2** illustrates a method to determine responsiveness of a driver of a vehicle to feedback regarding driving behaviors.

DETAILED DESCRIPTION

FIG. **1** illustrates a system **10** configured to provide feedback to a driver of vehicle **11** regarding driving behavior while operating vehicle **11**. Such feedback may be presented to the driver during the same driving session in which the driving behavior occurred. This may include providing feedback to the driver in real time, near real time, and/or at other times during the driving session. System **10** may be configured to monitor driving behavior during and/or after provision of such feedback. From this monitoring, system **10** may determine responsiveness of a driver of vehicle **11** to feedback regarding driving behaviors. System **10** may include one or more of first processor **12***a*, second processor **12***b*, electronic storage **13**, sensor **14**, feedback devices **15**, and/or other components. Feedback devices **15** may include one or more of display **16**, speaker **17**, haptic generator **18**, and/or other feedback devices. Some or all of system **10** may be installed in vehicle **11** and/or be otherwise coupled, directly or indirectly, with vehicle **11**. By way of non-limiting example, second processor **12***b* may be located remotely from vehicle **11**, while first processor **12***a*, sensor **14**, display **16**, speaker **17**, and haptic generator **18** may be located on or in vehicle **11**. By way of non-limiting example, second processor **12***b* may be in a server located remotely from vehicle **11** and may communicate with first processor **12***a*, sensor **14**, display **16**, speaker **17**, haptic generator **18**, and/or other components over network **19**. Electronic storage **13** may be located remotely from vehicle **11**, or on or in vehicle **11**. Electronic storage **13** may be located remotely from first processor **12***a* and/or second processor **12***b*.

Electronic storage **13** may comprise electronic storage media that electronically stores information. The electronic storage media of electronic storage **13** may comprise one or both of system storage that is provided integrally (i.e., substantially non-removable) with system **10** and/or removable storage that is removably connectable to system **10** via, for example, a port (e.g., a USB port, a firewire port, etc.) or a drive (e.g., a disk drive, etc.). Electronic storage **13** may comprise one or more of optically readable storage media (e.g., optical disks, etc.), magnetically readable storage media (e.g., magnetic tape, magnetic hard drive, floppy drive, etc.), electrical charge-based storage media (e.g., EEPROM, RAM, etc.), solid-state storage media (e.g., flash drive, etc.), and/or other electronically readable storage media. Electronic storage **13** may store software instructions, driving behavior information, trigger information, feedback information, information relating to the provision of feedback, driver responsiveness information, information determined by first processor **12***a*, information determined by second processor **12***b*, and/or other information that enables system **10** to function properly. Electronic storage **13** may be (in whole or in part) a separate component within system **10**, or electronic storage **13** may be provided (in whole or in part) integrally with one or more other components of system **10**. By way of non-limiting example, electronic storage **13** may include one or more memory of first processor **12***a*, memory of second processor **12***b*, electronic storage coupled to first processor **12***a*, electronic storage coupled to second processor **12***b*, and/or other electronic storage.

Although electronic storage **13** is shown in FIG. **1** as a single entity, this is for illustrative purposes only. In some implementations, electronic storage **13** may comprise a plurality of storage units. These storage units may be physically located within the same device (e.g., a vehicle event recorder), or electronic storage **13** may represent storage functionality of a plurality of devices operating in coordination.

Sensor **14** may be configured to generate output signals conveying driving behavior information. Sensor **14** may include one or more of image sensors, audio sensors, temperature sensors, humidity sensors, vehicle speed sensors, wheel speed sensors, proximity sensors, pressure sensors, seat belt sensors, accelerometers, tilt sensors, inclination sensors, angular rate sensors, gyroscopes, geolocation sensors, magnetometers, radar detectors, radar sensors, vibration sensors, light detection sensors, ECM sensors, physiological sensors, tachographs, user input devices, and/or other sensors. In some implementations, the driving behavior information may include one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information,

vehicle status information, driver status information, and/or other driving behavior information.

Although sensor **14** is depicted in FIG. **1** as a single element, this is not intended to be limiting. Sensor **14** may include one or more sensors located adjacent to and/or in communication with the various mechanical systems of vehicle **11**, in one or more positions (e.g., at or near the front of vehicle **11**) to accurately acquire information representing the vehicle environment (e.g. visual information, spatial information, orientation information), and/or in other locations. For example, in some implementations, sensor **14** may include one or more on-board diagnostics sensors of vehicle **11**. In some implementations, sensor **14** may include one or more accelerometers to detect sudden acceleration/deceleration of vehicle **11**. Other sensors are contemplated

One or more feedback devices **15** may be included on or in vehicle **11**. The one or more feedback devices **15** may include one or more of display **16**, speaker **17**, haptic generator **18**, and/or other feedback devices. Feedback devices **15** may be configured to provide feedback defined by feedback information to the driver of vehicle **11**.

Display **16** may provide feedback to the driver through visual information presented on display **16**. Display **16** may be integrated with vehicle **11**. By way of non-limiting example, display **16** may include one or more of a dashboard display, a global positioning system (GPS) navigation display, a front view camera display, a rear view camera display, and/or other displays. Display **16** may not be integral with vehicle **11**. By way of non-limiting example, display **16** may include one or more of aftermarket display, computer, laptop, tablet, smartphone, and/or other displays.

Speaker **17** may provide feedback through audio information. Speaker **17** may include a speaker in a sound system of vehicle **11**. Speaker **17** may not be integral with vehicle **11**. Speaker **17** may include a headphone, an earphone, a headset, an earset, and/or other speakers. Speaker **17** may include a speaker associated with display **16**.

Haptic generator **18** may provide feedback through haptic information. The haptic information may include vibration, motion, temperature changes, and/or other haptic information. For example, vibration and/or haptic feedback may be short, long, and/or of varying intensity. The intensity of vibration and/or haptic feedback may vary over time. Haptic generator **18** may be located in one or other places inside vehicle **11**. By way of non-limiting example, haptic generator **18** may be located in a seat, a headrest, an armrest, a driving wheel, a door, a floor, and/or other locations in the vehicle. Haptic generator **18** may not be integral with vehicle **11**. For example, haptic generator **18** may include a device or an object associated with the driver of vehicle **11**, such as a computer, laptop, tablet, smartphone, headphone, earphone, headset, earset, headwear, smartwatch, fitness band, wristwear, and/or other device or object.

One or more components of system **10** may communicate with each other through hard-wired communication, wireless communication, or both. For example, second processor **12***b* may communicate with sensor **14** over a wireless network. Other types of communications are contemplated by the present disclosure. By way of non-limiting example, wireless communication may include one or more of radio communication, Bluetooth communication, Wi-Fi communication, cellular communication, infrared communication, or other wireless communication.

First processor **12***a* and/or second processor **12***b* may be configured to provide information processing capabilities in system **10**. As such, first processor **12***a* and/or second processor **12***b* may comprise one or more of a digital processor, an analog processor, a digital circuit designed to process information, a central processing unit, a graphics processing unit, a microcontroller, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information.

First processor **12***a* and/or second processor **12***b* may be configured to execute one or more computer program components. The computer program components may include one or more of sensing component **20**, trigger component **21**, feedback component **22**, provision component **23**, response component **24**, feedback adjustment component **25** and/or other components. By way of non-limiting example, first processor **12***a* may be configured to execute one or more of sensing component **20**, trigger component **21**, feedback component **22**, provision component **23**, and/or other components, and second processor **12***b* may be configured to execute one or more of response component **24**, feedback adjustment component **25**, and/or other components. The computer program components configured to be executed by first processor **12***a* and second processor **12***b* may not be exclusive to one processor. By way of non-limiting example, both first processor **12***a* and second processor **12***b* may be configured to execute sensing component **20**. First processor **12***a* and second processor **12***b* may be configured to execute the same computer program component at the same time or at different times.

Sensing component **20** may be configured to obtain driving behavior information. The driving behavior information may characterize operation of vehicle **11** by the driver. The operation of vehicle **11** may be characterized by one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information, vehicle status information, driver status information, and/or other driving behavior information. Sensing component **20** may be configured to obtain driving behavior information at different times. Sensing component **20** may be configured to obtain driving behavior information prior to provision of feedback to the driver of vehicle **11**, and during and/or subsequent to the provision of the feedback to the driver.

Visual information may include one or more of an image, a video, and/or other visual information. Visual information may include one or more visual information regarding vehicle **11**, objects inside vehicle **11**, objects outside vehicle **11**, amount of light around vehicle **11**, and/or other visual information. Audio information may include one or more audio information regarding audio from vehicle **11**, audio inside vehicle **11**, audio outside vehicle **11**, and/or other audio information.

Motion information may include one or more motion information regarding speed of vehicle **11**, distance traveled by vehicle **11**, and/or movement of vehicle **11**, including one or more of moving forward, moving backwards, moving right, moving left, turning left, turning right, and/or other movement, and/or other motion information. Acceleration information may include one or more acceleration information regarding acceleration of vehicle **11**, including acceleration and/or deceleration of vehicle **11** in any direction or angle, and/or other acceleration information.

Location information may include one or more location information regarding the location of vehicle **11**, including location determined by a GPS, location on or off a road, location inside or outside a structure (e.g., building, parking lot, garage, etc.), and/or other location information. Spatial information may include one or more spatial information

regarding the space around vehicle **11**, including distance between vehicle **11** and nearby objects (e.g., sign, guard rail, post, person, animal, vehicle, structure, road marking, such as white line, yellow line, stop line, etc.), direction from vehicle **11** to nearby objects, and/or other spatial information. Orientation information may include one or more orientation information regarding vehicle **11** relative to the space around vehicle **11**, including the orientation of vehicle **11** relative to nearby objects, and/or other orientation information.

Tilt information may include one or more tilt information regarding left or right sloping position and/or movement of vehicle **11**, and/or other tilt information. Inclination/declination information may include one or more inclination/declination information regarding upward or downward sloping position and/or movement of vehicle **11**, and/or other inclination/declination information. Vibration information may include one or more vibration information regarding vibration of vehicle **11**, one or more components of vehicle **11**, and/or haptic generator **18**, including the duration and/or intensity of vibration, and/or other vibration information. Time information may include one or more time information regarding the time of day, duration relating to one or more driving behavior information, and/or other time information.

Vehicle status information may include one or more vehicle status information regarding physical features of vehicle **11**, mechanical systems of vehicle **11**, and/or other vehicle status information. Physical features of vehicle **11** may include physical features of vehicle **11** set during manufacture of vehicle **11**, during loading of vehicle **11**, and/or at other times. Physical features of vehicle **11** may include vehicle type (e.g., a car, a bus, a semi-truck, a tanker truck), a vehicle size (e.g., length), a vehicle weight (e.g., including cargo and/or without cargo), a number of gears, a number of axles, a type of load carried by vehicle **11** (e.g., food items, livestock, construction materials, hazardous materials, an oversized load, a liquid), vehicle trailer type, trailer length, trailer weight, trailer height, a number of trailer axles, and/or other physical features.

Mechanical systems of vehicle **11** may include an engine, a drive train, lighting systems (e.g., headlights, brake lights), a braking system, a transmission, fuel delivery systems, and/or other mechanical systems. By way of non-limiting example, vehicle status information regarding mechanical systems of vehicle **11** may include amount of fuel, temperature of engine, temperature inside and/or outside vehicle **11**, amount of air pressure inside one or more tires, whether one or more tires are flat, gear in use, whether horn is being used, whether seatbelt is being used, whether one or more doors are open or closed, information from the vehicle ECM system/sensors, whether vehicle **11** is operating (e.g., turned on and/or being driven, etc.), whether vehicle **11** is not operating (e.g., turned off and/or not being driven, etc.), and/or other mechanical systems information.

Driver status information may include one or more driver status information regarding the driver of vehicle **11**. By way of non-limiting example, driver status information regarding the driver may include whether the driver is alert, whether driver is sleepy or sleeping, whether driver is using a headphone, whether driver is watching the road, whether the driver is distracted, whether the driver is watching TV, whether the driver is eating, whether the driver is driving with one hand, whether the driver is talking on the phone, the driver's historical accident information, the driver's historical traffic violation information, the driver's historical driving pattern information, and/or other driver status information.

Driver status information may be generated by one or more sensors. By way of non-limiting example, an image sensor may count the number of time vehicle **11** swerves within a certain duration of time to determine whether the driver is sleepy or sleeping. For example, an image sensor may be used to track the driver's eye or head movements and a physiological sensor may be used to track the driver's heart rate to determine whether the driver is sleepy or sleeping. As another example, user input devices (e.g., keyboard, keypad, touchscreen, mouse, etc.) may be used to identify the driver.

Trigger component **21** may be configured to determine an occurrence of a trigger based on the driving behavior information. The trigger may indicate a specific driving behavior. An occurrence of a trigger may be determined as described below, or as described in U.S. Pat. No. 8,892,310, entitled "SYSTEM AND METHOD TO DETECT EXECUTION OF DRIVING MANEUVERS," the foregoing being incorporated herein by reference in its entirety. The specific driving behavior may include one or more of specific driving maneuver, specific driving context, specific vehicle status, specific driver status, and/or other specific driving behavior. In some implementations, one or more triggers may be based on the identity of the driver. For example, a driver may be identified through one or more inputs entered via one or more user input devices. Trigger component **21** may determine an occurrence of a trigger that is specific to the identified driver.

Trigger component **21** may be configured to determine that a trigger has occurred when the driving behavior information indicates occurrence of one or more of a specific driving maneuver, a specific driving context, a specific vehicle status, a specific driver status, and/or other specific driving behavior corresponding to the specific driving behavior. Criteria for occurrence of one or more triggers may be referred to as a trigger logic. The trigger logic may be programmed into trigger component **21**, updated by trigger component **21**, obtained by trigger component **21** from electronic storage **13**, obtained by trigger component **21** from remote location, and/or obtained by trigger component **21** in other ways.

A driving maneuver may refer to one or more motions and/or operations of vehicle **11**. The motion of a vehicle may refer to motion of the vehicle at a time, motion of the vehicle over a period of time, motion of the vehicle at a location, and/or motion of the vehicle over a distance. The operation of a vehicle may refer to operation of the vehicle at a time, operation of the vehicle over a period of time, operation of the vehicle at a location, and/or operation of the vehicle over a distance. A specific driving maneuver may be defined by one or more of specific visual information, specific audio information, specific motion information, specific acceleration information, specific location information, specific spatial information, specific orientation information, specific tilt information, specific inclination/declination information, specific vibration information, specific time information, and/or other specific driving behavior information.

By way of non-limiting example, the specific driving maneuver may include swerving, a U-turn, freewheeling, over-revving, lane-departure, short following distance, imminent collision, unsafe turning that approaches rollover and/or vehicle stability limits, hard braking, rapid acceleration, idling, driving outside geo-fence boundary, crossing double-yellow lines, passing on single-lane roads, a certain number of lane changes within a certain amount of time or

distance, fast lane change, cutting off other vehicles during lane-change speeding, running a red light, running a stop sign, and/or other driving maneuvers.

A driving context may refer to one or more conditions around and/or inside vehicle **11**. The condition around and/or inside a vehicle may refer to one or more permanent and/or transitory state of the environment around and/or inside the vehicle that may impact the driver's ability to operate the vehicle and/or the operation of the vehicle. A specific driving context may be defined by one or more of specific visual information, specific audio information, specific motion information, specific acceleration information, specific location information, specific spatial information, specific orientation information, specific tilt information, specific inclination/declination information, specific vibration information, specific time information, specific vehicle status information, specific driver status information, and/or other specific driving behavior information.

By way of non-limiting example, the specific driving context may include location of vehicle **11** (e.g., on or off different types of road, inside or outside different types of structure, on or of a driving shoulder, on a slope, altitude, etc.), condition around vehicle **11** (e.g., weather, rain, snow, hail, fog, temperature, humidity, lighting condition, visibility, time of day, traffic information, grade of road, road type surface, slippery or icy surface, etc.), proximity and/or orientation to objects near vehicle **11**, geofence around vehicle **11**, condition inside vehicle **11**, passengers or objects inside vehicle **11**, lighting condition inside vehicle **11**, sound condition inside vehicle **11**, and/or other driving context.

A vehicle status may refer to one or more conditions of vehicle **11**. The condition of a vehicle may refer to one or more permanent and/or transitory state of the vehicle, including one or more operating state of the vehicle and/or one or more components of the vehicle, that may impact the driver's ability to operate the vehicle and/or the operation of the vehicle. A specific vehicle status may be defined by one or more specific vehicle status information and/or other specific driving behavior information. The specific vehicle status may include specific information regarding one or more of physical features of vehicle **11**, including type, size, weight and/or other physical features of vehicle **11**, load of vehicle **11**, including type, size, weight, loading status, and/or other status of load of vehicle **11**, and/or mechanical systems of vehicle **11**.

By way of non-limiting example, the specific vehicle status may include specific status of engine, drive train, light system, breaking system, transmission, fuel delivery system, and/or other mechanical systems, amount of fuel, temperature of engine, temperature inside and/or outside vehicle **11**, amount of air pressure inside one or more tires, whether one or more tires are flat, gear in use, whether horn is being used, whether seatbelt is being used, whether one or more doors are open or closed, whether vehicle **11** is operating (e.g., turned on and/or being driven, etc.), how long vehicle **11** has been operating, whether vehicle **11** is not operating (e.g., turned off and/or not being driven, etc.), how long vehicle **11** has not been operating, how long vehicle **11** has not been operating when vehicle **11** is operated (e.g., turned on and/or being driven, etc.), and/or other specific vehicle status.

A driver status may refer to one or more conditions of the driver of vehicle **11**. The condition of a driver may refer to one or more permanent and/or transitory state of the driver, including one or more physical and/or emotional state of the driver, that may impact the driver's ability to operate the vehicle and/or the operation of the vehicle. A specific driver status may be defined by one or more specific driver status information and/or other specific driving behavior information.

By way of non-limiting example, the specific driver status may include whether the driver is alert, whether driver is sleepy or sleeping, whether driver is using a headphone, whether driver is watching the road, whether the driver is distracted, whether the driver is watching TV, whether the driver is eating, whether the driver is driving with one hand, whether the driver is talking on the phone, and/or other specific driver status.

Feedback component **22** may be configured to obtain feedback information regarding the specific driving behavior. The feedback information may define feedback regarding the specific driving behavior to be provided to the driver. Such feedback information may define feedback type(s) for the feedback, information to be provided to the driver in the feedback, and/or other aspects of the feedback. The feedback type(s) may include one or more of visual feedback, audio feedback, haptic feedback, and/or other feedback.

The information to be provided to the driver may include one or more of identification of the specific driving behavior, description of the specific driving behavior information, instruction regarding the specific driving behavior, warning regarding the specific driving behavior, and/or any other communicable information. By way of non-limiting example, feedback information may include an identification that a tire of vehicle **11** is low on air pressure, a description regarding off-the-road location of vehicle **11**, a visual image of objects behind vehicle **11**, an instruction to fill up the gas tank of vehicle **11** at the next stop, a warning that the speed of vehicle **11** is faster than the speeding limit, and/or any other communication.

The feedback information may be programmed into feedback component **22**, updated by feedback component **22**, obtained by feedback component **22** from electronic storage **13**, obtained by feedback component **22** from remote location, and/or obtained by feedback component **22** in other ways. For example, the feedback information may be a voice recording of the driver's supervisor regarding the specific driving behavior that is remotely obtained by feedback component **22**.

Provision component **23** may be configured to effectuate provision of feedback defined by the feedback information to the driver of vehicle **11**. In some implementations, provision component **23** may effectuate the provision of the feedback to the driver by operating one or more feedback devices **15**, including one or more of display **16**, speaker **17**, haptic generator **18**, and/or other feedback devices. By way of non-limiting example, provision component **23** may effectuate the provision of the feedback by operating display **16** and speaker **17**. Display **16** may display the feedback information while speaker **17** audibly communicates the feedback information or produces sound to indicate to the driver that the feedback information is displayed on display **16**. In some implementations, provision component **23** may be configured to select one or more of feedback devices **15**, including one or more display **16**, speaker **17**, haptic generator **18**, and/or other feedback devices, to effectuate the provision of the feedback to the driver.

Response component **24** may be configured to assess responsiveness of the driver to the feedback based on the driving behavior information obtained during and/or subsequent to the provision of the feedback. Responsiveness of the driver may refer to how the driver acts when feedback is provided to the driver. How a driver acts may refer to any or

no changes made by the driver, during and/or subsequent to the provision of the feedback, that may impact the driver's ability to operate the vehicle and/or the operation of the vehicle. Assessing the responsiveness of the driver to the feedback may include measuring the amount of time the driver takes to respond to the feedback, measuring the amount of driving changes the driver makes to the feedback, determining whether the driver ignores the feedback, and/or any other comparison between the driving behavior information obtained prior to the provision of the feedback and the driving behavior information obtained during and/or subsequent to the provision of the feedback. For example, assessing responsiveness of a driver to feedback regarding vehicle **11** being close to a guard rail may include determining how far the driver moves vehicle **11** away from the guard rail and how long it takes for the driver to move vehicle **11** away from the guard rail after the feedback provision.

The operation of vehicle **11** during and/or subsequent to the provision of the feedback may be characterized by different type of information from those relating to one or more of the specific driving maneuver, the specific driving context, the specific vehicle status, the specific driver status, and/or the other specific driving behavior corresponding to the specific driving behavior. By way of non-limiting example, determining whether a driver ignores feedback regarding an open door (for example, as indicated by vehicle status information) may include reviewing visual information inside vehicle **11** during and/or subsequent to the provision of the feedback to confirm that display **16** is providing the feedback information to the driver, and/or reviewing audio information inside vehicle **11** during and/or subsequent to the provision of the feedback to confirm that speaker **17** is providing the feedback information to the driver. If display **16** and/or speaker **17** is not providing the feedback information to the driver, response component **24** may determine that the driver is ignoring the feedback by having turned off or disconnected display **16** and/or speaker **17**.

In some implementations, assessing responsiveness of the driver to the feedback may include determining driver responsiveness information. The driver responsiveness information may include one or more of the driving behavior information, the feedback information, information relating to the provision of the feedback, including how and which one or more of feedback devices **15**, including one or more of display **16**, speaker **17**, haptic generator **18**, and/or other feedback devices, was operated to effectuate the provision of the feedback, information relating to the trigger, information relating to the responsiveness of the driver to the feedback, and/or other driver responsiveness information.

In some implementations, response component **24** may be configured to determine a driver responsiveness rating. The driver responsiveness rating may include one or more measurement and/or evaluation of the driver's responsiveness to the feedback. The driver responsiveness rating may use one or more characters, alphabetic characters, words, numeric characters, numbers, alphanumeric characters, roman numerals, special characters, percentages, colors, and/or other ratings. The driver responsiveness rating may reflect one or more of quality and/or quantity of the driver's responsiveness to the feedback. For example, a driver responsiveness rating for feedback regarding vehicle **11** being close to a guard rail may include a grade between A-F for how far the driver moves vehicle **11** away from the guard rail and a color to indicate how long it takes for the driver to move vehicle **11** away from the guard rail.

In some implementations, response component **24** may be configured to effectuate storage of the driver responsiveness information. The driver responsiveness information may be stored in electronic storage **13**. In some implementations, response component **24** may be configured to effectuate retrieval of prior driver responsiveness information. The prior driver responsiveness information may include driver responsiveness information stored in electronic storage **13**.

In some implementations, response component **24** may be configured to assess the responsiveness of the driver to the feedback based on the prior driver responsiveness information. In some implementations, response component **24** may compare current responsiveness of the driver to the feedback with prior driver responsiveness information. By way of non-limiting example, response component **24** may compare current responsiveness of the driver to the feedback with the driver's historical responsiveness reflected in the prior driver responsiveness information. In some implementations, response component **24** may assess responsiveness of the driver to the feedback by taking into account the prior driver responsiveness information.

In some implementations, the current responsiveness and the prior driver responsiveness information are based on the same trigger. In some implementations, the current responsiveness and the prior driver responsiveness information are based on different triggers. In some implementations, the current responsiveness and the prior driver responsiveness information are based on the same type of feedback provision. In some implementations, the current responsiveness and the prior driver responsiveness information are based on different types of feedback provision. For example, response component **24** may assess responsiveness of a driver to feedback regarding vehicle **11** being close to a guard rail by reviewing the driver's prior driver responsiveness to feedback regarding vehicle **11** being close to guard rails. If the prior driver responsiveness information indicates that the driver has repeatedly driven close to guard rails, response component **24** may determine a worse driver responsiveness rating for the driver than if the prior driver responsiveness information indicates that the driver has infrequently driven close to guard rails.

In some implementations, feedback adjustment component **25** may determine feedback type(s) for the feedback. Feedback adjustment component **25** may select one or more of feedback devices **15**, including one or more display **16**, speaker **17**, haptic generator **18**, and/or other feedback devices, based on the prior driver responsiveness information. In some implementations, feedback adjustment component **25** may make such selection based on which type of feedback provision leads to better driver responsiveness to feedback. For example, the prior driver responsiveness information may indicate that the driver of vehicle **11** is most responsive to feedback provided through speaker **17** and haptic generator **18**, and feedback adjustment component **25** may select speaker **17** and haptic generator **18** to effectuate provision of the feedback. In some implementations, feedback adjustment component **25** may update feedback type(s) in feedback information

Although first processor **12***a* and second processor **12***b* are shown in FIG. **1** as separate single entities, this is for illustrative purposes only. In some implementations, first processor **12***a* and/or second processor **12***b* may comprise a plurality of processing units. These processing units may be physically located within the same device (e.g., a vehicle event recorder), or first processor **12***a* and/or second processor **12***b* may represent processing functionality of a plurality of devices operating in coordination.

In some implementations, first processor **12***a* and second processor **12***b* may together comprise a single processor. By way of non-limiting example, first processor **12***a* and second processor **12***b* may be located in a single processing unit or a plurality of processing units physically located within the same device. By way of non-limiting example, first processor **12***a* and second processor **12***b* may be located in a server located remotely from vehicle **11** and may communicate with sensor **14**, display **16**, speaker **17**, haptic generator **18**, and/or other components over network **19**. By way of non-limiting example, first processor **12***a* and second processor **12***b* may be a single processor located in a vehicle event recorder of vehicle **11**.

FIG. **2** illustrates method **200** to determine responsiveness of a driver to feedback regarding driving behaviors. The operations of method **200** presented below are intended to be illustrative. In some implementations, method **200** may be accomplished with one or more additional operations not described, and/or without one or more of the operations discussed. In some implementations, two or more of the operations may occur substantially simultaneously.

In some implementations, method **200** may be implemented in one or more processing devices (e.g., a digital processor, an analog processor, a digital circuit designed to process information, a central processing unit, a graphics processing unit, a microcontroller, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices may include one or more devices executing some or all of the operations of method **200** in response to instructions stored electronically on one or more electronic storage mediums. The one or more processing devices may include one or more devices configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the operations of method **200**.

Referring to FIG. **2** and method **200**, at operation **201**, driving behavior information characterizing operation of a vehicle by a driver may be generated. The driving behavior information may include one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information, vehicle status information, driver status information, and/or other driving behavior information. In some implementations, operation **201** may be performed by one or more sensors the same as or similar to sensor **14** (shown in FIG. **1** and described herein).

At operation **202**, the driving behavior information characterizing the operation of the vehicle by the driver may be obtained. In some implementations, operation **202** may be performed by a processor component the same as or similar to sensing component **20** (shown in FIG. **1** and described herein).

At operation **203**, an occurrence of a trigger, the trigger indicating a specific driving behavior, may be determined. The specific driving behavior may include one or more of specific driving maneuver, specific driving context, specific vehicle status, specific driver status, and/or other specific driving behavior. The occurrence of the trigger may be determined based on occurrence of one or more of the specific driving maneuver, the specific driving context, the specific vehicle status, the specific driver status, and/or the other specific driving behavior. In some implementations, operation **203** may be performed by a processor component the same as or similar to trigger component **21** (shown in FIG. **1** and described herein).

At operation **204**, feedback information regarding the specific driving behavior may be obtained. The feedback information may define feedback regarding the specific driving behavior to be provided to the driver. Such feedback information may define feedback type(s) for the feedback, information to be provided to the driver in the feedback, and/or other aspects of the feedback. The feedback type(s) may include one or more of visual feedback, audio feedback, haptic feedback, and/or other feedback. The information to be provided to the driver may include one or more of identification of the specific driving behavior, description of the specific driving behavior, the driving behavior information, instruction regarding the specific driving behavior, warning regarding the specific driving behavior, and/or any other communicable information. In some implementations, operation **204** may be performed by a processor component the same as or similar to feedback component **22** (shown in FIG. **1** and described herein).

At operation **205**, provision of feedback defined by the feedback information may be effectuated to the driver. In some implementations, operation **205** may be performed by a processor component the same as or similar to provision component **23** (shown in FIG. **1** and described herein). In some implementations, operation **205** may be performed using one or more of feedback devices **15**, including one or more of display **16**, speaker **17**, haptic generator **18**, and/or other feedback devices (shown in FIG. **1** and described herein).

At operation **206**, driving behavior information characterizing operation of the vehicle by the driver during and/or subsequent to the feedback provision may be generated. The driving behavior information may include one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information, vehicle status information, driver status information, and/or other driving behavior information. In some implementations, operation **206** may be performed by one or more sensors the same as or similar to sensor **14** (shown in FIG. **1** and described herein).

At operation **207**, the driving behavior information characterizing the operation of the vehicle by the driver during and/or subsequent to the feedback provision may be obtained. In some implementations, operation **207** may be performed by a processor component the same as or similar to sensing component **20** (shown in FIG. **1** and described herein).

At operation **208**, responsiveness of the driver to the feedback may be assessed. Assessing the responsiveness of the driver to the feedback may include measuring the amount of time the driver takes to respond to the feedback, measuring the amount of driving changes the driver makes to the feedback, determining whether the driver ignores the feedback, and/or any other comparison between the driving behavior information obtained prior to the provision of the feedback and the driving behavior information obtained during and/or subsequent to the provision of the feedback. In some implementations, operation **208** may be performed by a processor component the same as or similar to response component **24** (shown in FIG. **1** and described herein).

Although the system(s) and/or method(s) of this disclosure have been described in detail for the purpose of illustration based on what is currently considered to be the most practical and preferred implementations, it is to be

understood that such detail is solely for that purpose and that the disclosure is not limited to the disclosed implementations, but, on the contrary, is intended to cover modifications and equivalent arrangements that are within the spirit and scope of the appended claims. For example, it is to be understood that the present disclosure contemplates that, to the extent possible, one or more features of any implementation can be combined with one or more features of any other implementation.

What is claimed is:

1. A system configured to determine responsiveness of a driver of a vehicle to feedback regarding driving behaviors, the system comprising:

one or more processors configured by machine readable instructions to:

obtain first driving behavior information that characterizes operation of the vehicle by the driver;

determine an occurrence of a trigger based on the first driving behavior information, the trigger indicating a specific driving behavior;

obtain feedback information correlating to the specific driving behavior;

effectuate provision of feedback defined by the feedback information to the driver to prompt the driver to curb the specific driving behavior;

obtain second driving behavior information that characterizes operation of the vehicle by the driver during and/or subsequent to the provision of the feedback; and

assess responsiveness of the driver to the feedback based on the second driving behavior information, wherein assessing the responsiveness of the driver includes determining whether the driver curbs the specific driving behavior during and/or subsequent to the provision of the feedback.

2. The system of claim **1**, further comprising:

a sensor configured to generate output signals conveying one or more of the first driving behavior information and/or the second driving behavior information.

3. The system of claim **2**, wherein the sensor includes one or more of an image sensor, an audio sensor, a temperature sensor, a humidity sensor, a vehicle speed sensor, a wheel speed sensor, a proximity sensor, a pressure sensor, a seat belt sensor, an accelerometer, a tilt sensor, an inclination sensor, an angular rate sensor, a gyroscope, a geolocation sensor, a magnetometer, a radar detector, a radar sensor, a vibration sensor, a light detection sensor, an ECM sensor, a physiological sensor, a tachograph, and/or a user input device.

4. The system of claim **1**, wherein the one or more processors are further configured to effectuate provision of the feedback to the driver by operating one or more of a display, a speaker, and/or a haptic generator.

5. The system of claim **1**, wherein the one or more processors are further configured to generate a driver responsiveness rating, the driver responsiveness rating characterizing whether the driver curbs the specific driving behavior during and/or subsequent to the provision of the feedback.

6. The system of claim **1**, wherein the first driving behavior information and the second driving behavior information include one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information, vehicle status information, and/or driver status information.

7. The system of claim **1**, wherein the one or more processors are further configured to:

effectuate storage of driver responsiveness information, the driver responsiveness information including one or more of the first driving behavior information, the second driving behavior information, the feedback information, information relating to the provision of the feedback, information relating to the trigger, and/or information relating to the responsiveness of the driver to the feedback; and

effectuate retrieval of prior driver responsiveness information.

8. The system of claim **7**, wherein the one or more processors are further configured to assess the responsiveness of the driver to the feedback based on the prior driver responsiveness information.

9. The system of claim **7**, wherein the one or more processors are further configured to select one or more of a display, a speaker, and/or a haptic generator to effectuate the provision of the feedback to the driver, wherein such selection is based on the prior driver responsiveness information.

10. The system of claim **1**, wherein the one or more processors comprise a first processor located on or in the vehicle and a second processor remotely located from the vehicle.

11. A method to determine responsiveness of a driver of a vehicle to feedback regarding driving behaviors, the method comprising:

obtaining first driving behavior information that characterizes operation of the vehicle by the driver;

determining an occurrence of a trigger based on the first driving behavior information, the trigger indicating a specific driving behavior;

obtaining feedback information correlating to the specific driving behavior;

effectuating provision of feedback defined by the feedback information to the driver to prompt the driver to curb the specific driving behavior;

obtaining second driving behavior information that characterizes operation of the vehicle by the driver during and/or subsequent to the provision of the feedback; and

assessing responsiveness of the driver to the feedback based on the second driving behavior information, wherein assessing the responsiveness of the driver includes determining whether the driver curbs the specific driving behavior during and/or subsequent to the provision of the feedback.

12. The method of claim **11**, wherein output signals conveying one or more of the first driving behavior information and/or the second driving behavior information are generated by a sensor.

13. The method of claim **12**, wherein the sensor includes one or more of an image sensor, an audio sensor, a temperature sensor, a humidity sensor, a vehicle speed sensor, a wheel speed sensor, a proximity sensor, a pressure sensor, a seat belt sensor, an accelerometer, a tilt sensor, an inclination sensor, an angular rate sensor, a gyroscope, a geolocation sensor, a magnetometer, a radar detector, a radar sensor, a vibration sensor, a light detection sensor, an ECM sensor, a physiological sensor, a tachograph, and/or a user input device.

14. The method of claim **11**, wherein the effectuating provision of the feedback to the driver includes operating one or more of a display, a speaker, and/or a haptic generator.

15. The method of claim **11**, further comprising generating a driver responsiveness rating, the driver responsiveness

rating characterizing whether the driver curbs the specific driving behavior during and/or subsequent to the provision of the feedback.

16. The method of claim **11**, wherein the first driving behavior information and the second driving behavior information include one or more of visual information, audio information, motion information, acceleration information, location information, spatial information, orientation information, tilt information, inclination/declination information, vibration information, time information, vehicle status information, and/or driver status information.

17. The method of claim **11**, further comprising:

effectuating storage of driver responsiveness information, the driver responsiveness information including one or more of the first driving behavior information, the second driving behavior information, the feedback information, information relating to the provision of the feedback, information relating to the trigger, and/or information relating to the responsiveness of the driver to the feedback.

18. The method of claim **17**, wherein the assessing the responsiveness of the driver to the feedback based on the second driver behavior information takes into account the stored driver responsiveness information.

19. The method of claim **17**, further comprising selecting one or more of a display, a speaker, and/or a haptic generator to effectuate the provision of the feedback to the driver, wherein such selection is based on the stored driver responsiveness information.

20. A system configured to determine responsiveness of a driver of a vehicle to feedback regarding driving behaviors, the system comprising:

a first processor located on or in the vehicle, the first processor configured by machine readable instructions to:

obtain first driving behavior information that characterizes operation of the vehicle by the driver;

determine an occurrence of a trigger based on the first driving behavior information, the trigger indicating a specific driving behavior;

obtain feedback information correlating to the specific driving behavior;

effectuate provision of feedback defined by the feedback information to the driver to prompt the driver to curb the specific driving behavior;

a second processor remotely located from the vehicle, the second processor configured by machine readable instructions to:

obtain second driving behavior information that characterizes operation of the vehicle by the driver during and/or subsequent to the provision of the feedback; and

assess responsiveness of the driver to the feedback based on the second driving behavior information, wherein assessing the responsiveness of the driver includes determining whether the driver curbs the specific driving behavior during and/or subsequent to the provision of the feedback; and

a sensor configured to generate output signals conveying one or more of the first driving behavior information and/or the second driving behavior information.

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